

**Method and Apparatus for Digital Detection of Electromagnetic Signal Strength and
Signal Direction in Metallic Pipes and Cables**

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ABSTRACT

A new digital architecture for metallic pipe and cable locators, providing accurate estimation of the fundamental locate parameters, electromagnetic signal strength and signal direction, and utilizing a nested Digital Phase-Locked Loop (DPLL) structure is disclosed. The obstacles to signal direction measurement in low SINR environments using the signal select method are overcome and a more precise phase comparison between the carrier and the FM modulation signals is obtained. The architecture further significantly reduces analog front-end hardware requirements, offers wider resistance to component tolerances, lower calibration and test time, and provides flexible frequency selectivity. Locators according to the present invention provide accurate estimation of the fundamental physical parameters of line location (electromagnetic signal strength and signal direction) in extremely noisy environments, using Digital Signal Processing (DSP) methods.